PATENT ABSTRACTS OF JAPAN

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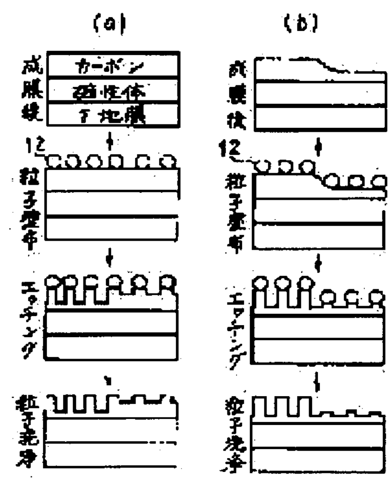
(54) FORMATION OF RUGGEDNESS AND PRODUCTION OF MAGNETIC RECORDING MEDIUM

(57)Abstract:
PURPOSE: To provide a method for forming ruggedness by which the reproducibility of etching is ensured, precision is enhanced, process for forming ruggedness is shortened, tolerance for the process is imparted and the investment cost of equipment can be reduced when groups of protrusions different from each other in height are formed in plural regions.
CONSTITUTION: A mask material-consisting of fine particles 12 is disposed on the surface of a substrate, this substrate is put in a vacuum vessel, etching gas is introduced into the vessel and plasma is generated. The surface of the substrate is etched while partially varying the density of plasma and groups of protrusions different from each other in height are simultaneously formed in plural regions of the substrate.



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CLAIMS

[Claim(s)]

[Claim 1] The formation approach of the irregularity characterized by installing the base with which the mask material which becomes a front face from a particle has been arranged in a vacuum housing, introducing desired etching gas in a vacuum housing, generating the plasma, etching a base front face, and forming the irregularity of height mutually different, respectively in two or more fields of a base at coincidence.

[Claim 2] the above -- the formation approach of the irregularity according to claim 1 characterized by performing formation of the irregularity of mutually different height by changing the consistency of the above-mentioned plasma mutually in the upper part of two or more above-mentioned fields.

[Claim 3] The above-mentioned etching gas is the formation approach of the irregularity according to claim 1 or 2 characterized by being at least one sort of gas chosen from the group which consists of oxygen, an argon, nitrogen, neon, a krypton, a fluorine, a fluorine compound, chlorine, and a chlorine compound.

[Claim 4] It is the formation approach of irregularity given in any 1 of claims 1-3 characterized by performing the above-mentioned etching by the pressure of the range of 0.05Torr - 1.0Torr.

[Claim 5] The above-mentioned etching is the formation approach of irregularity given in any 1 of claims 1-4 characterized by carrying out on the conditions from which the difference of the etch rate of two or more above-mentioned fields serves as the range of 0.5 nm/sec - 3 nm/sec.

[Claim 6] The manufacture approach of the magnetic-recording medium by which it is having-process which applies formation approach of irregularity publication to process [which forms a magnetic film on a nonmagnetic substrate], process [which forms a protective coat on this magnetic film], and any 1 of claims 1-5, and forms irregularity of mutually different height in two or more fields of above-mentioned protective coat characterized.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the approach of forming irregularity in a substrate front face, and the manufacture approach of the magnetic-recording medium using the approach by etching.
[0002]
[Description of the Prior Art] In the field of the magnetic disk which is a magnetic-recording medium, high recording density-ization progresses quickly in recent years, therefore the flying height of the magnetic head is becoming low steadily. Although about 20nm of thickness of the protective coat of a magnetic disk had been made very thin from about 40nm that it should correspond to this, in order to maintain ********-proof, the limitation was generated naturally. Then, the data zone reduced the granularity of the front face, and lowered the flying height of the magnetic head, and the so-called zone texture method with which the front face of the zone (henceforth a CSS zone) for carrying out the contact start stop of the magnetic head makes granularity coarser than the front face of a data zone has been developed as indicated by JP,64-76555,A, JP,4-11324,A, etc.
[0003] Conventionally, the approach indicated by JP,3-295086,A is learned as the manufacture approach of such a magnetic disk. This approach forms the substrate film, a magnetic film, and a protective coat on a substrate, as shown in drawing 1 . The whole surface is etched after applying the particle 12 used as a mask to the protective coat front face of a CSS zone. A hill (heights) is formed in a CSS zone, a data zone is etched into the whole surface, next, a particle is again made into the whole surface with **, the whole surface is etched, and the hill where height differs is established in a data zone and a CSS zone, respectively. Moreover, after masking the CSS zone first and etching a data area into the whole surface, the approach of making a particle the whole surface with **, etching a CSS zone and a data zone into it separately respectively, and forming the same front face in it was also performed.
[0004]
[Problem(s) to be Solved by the Invention] The above-mentioned conventional technique required the above very complicated and long stroke. Therefore, there was a problem in respect of repeatability, precision, process tolerance, and facility cost.
[0005] When forming the irregularity from which height differs mutually by the field, it secures the repeatability in etching, and raises precision, and the 1st purpose of this invention shortens the stroke of concavo-convex formation, gives process tolerance, and is to offer the formation approach of the irregularity which enables control of the amount of capital investment further.
[0006] The 2nd purpose of this invention is to offer the manufacture approach of a magnetic-recording medium of having used the formation approach of such irregularity.
[0007]
[Means for Solving the Problem] In order to attain the 1st purpose of the above, the formation approach of the irregularity of this invention arranges the mask material which consists of a particle on the surface of a base, installs this in a vacuum housing, introduces etching gas into it, generates the plasma, etches a base front face, and forms the irregularity of height mutually different, respectively in two or more fields of a base at coincidence.

[0008] Moreover, in order to attain the 2nd purpose of the above, a magnetic film is prepared on a nonmagnetic substrate and it prepares a protective coat at least on it, or it described above the manufacture approach of the magnetic-recording medium of this invention on this, it applies the concavo-convex formation approach explained below, and forms the irregularity of mutually different height in two or more of those fields.
[0009] In order to form the irregularity of such mutually different height, it is desirable to change the consistency of the plasma mutually in the upper part of two or more fields. What is necessary is just to change partially the distance of a substrate and the counterelectrode which counters it, in order to change the consistency of the plasma partially. Although it cannot generally be determined since it is necessary to change this distance with a process gas pressure and and it changes also with the dimensions of a facility, it is desirable to make it into twice [about] the distance of the ion sheath about determined by the process gas pressure to about 5 times. Thereby, it can be 0.5nm [/second] or more separate with an etch rate. As for the difference of the etch rate of each field, it is desirable to consider as the range of 0.5 nm/sec - 3 nm/sec. Moreover, etching may be formed only in one field of a base, or may be formed in both sides at coincidence.
[0010] At least one sort of gas of oxygen, an argon, nitrogen, neon, a krypton, a fluorine, a fluorine compound, chlorine, and the chlorine compounds can be used for etching gas. That is, physical etching gas, such as argon gas, can also be used in addition to the gas of a reactive operation of oxygen etc.

[0011] Although a process gas pressure changes strictly with the types of gas and the etched ingredients to be used, when etching the carbon protective coat generally used with the magnetic disk, for example with oxygen gas, in order to secure 0.5 or more nm/sec for the etching speed difference, the range of about 50 mTorr(s) to 1Torr is suitable for it.
[0012] As for the mean particle diameter, it is [that the ingredient used from the former should just be used for the particle used as mask material] desirable that it is 0.1-1 micron phi extent. When forming irregularity in a magnetic-recording medium, as for the height, it is desirable that the lower one is 0nm - about several nm, and, as for the higher one, it is desirable that it is higher than it about 5-20nm.
[0013]
[Function] As mentioned above, a partial etch rate can be gathered by raising a plasma consistency partially. When changing the distance of a substrate and the counterelectrode (ground electrode in this case) which counters, since the effect of electric field is so large that it is close to a counterelectrode, it becomes possible to raise the plasma consistency in that part. Thereby, a partial etch rate can be gathered. In addition, if distance of a substrate and a counterelectrode is made extremely narrow, the plasma will not generate this part but etching will be impossible in this part. If this approach is used, the field where concavo-convex height is different by one etching can be formed in coincidence, and the process precision of the etching [itself] will also improve sharply by compaction of a process, and simplification.
[0014]
[Example] Hereafter, the example of this invention is explained to a detail. First, the contents of evaluation and an approach are explained. The amount of etching measured and computed the height of the irregularity after etching using the sensing-pin-type surface roughness meter. The measurement machine used for measurement used the three-dimension surface roughness meter by Kosaka Laboratory, Ltd. The etch rate was deduced from this data as an amount of etching per unit time amount.
[0015] The process shown in drawing 2 (a) performed the experiment procedure. Surface roughness Ra carried out nickel-P plating, using a super polish substrate (the Sumitomo light metal company make, the aluminum, diameter of 95mm) 1.0nm or less as a substrate for magnetic disks, and what formed the chromium film with a thickness of 35nm, the cobalt alloy magnetic film with a thickness of 30nm, and the carbon protective coat with a thickness of 25nm as substrate film was prepared by sputtering.
[0016] The liquid which made the solvent distribute the particle 12 of the Teflon of 1 micron phi used as mask material all over the protective coat side (spatter carbon) of this magnetic disk is sprayed. After carrying out with ** by 5% per area of consistency, it sets into the etching system explained in full detail behind. Perform evacuation for the inside of a vacuum housing to 1x10 to 5 or less Torrs, and, subsequently to in a container, oxygen gas (purity 99.99up%) is sent in as etching gas. After making it fixed to the pressure (this example 1mTorr - 5Torr) of a request of the pressure in a container, the protective coat on the front face of a substrate was etched into the substrate for RF power (13.56MHz) fixed power (this example 50 W-500W) and by carrying out fixed time amount impression. Washing removal of the Teflon particle of mask material was carried out by washing in cold water after this, and it evaluated by carrying out spin desiccation.
[0017] The electrode configuration used what was shown in drawing 3 with the equipment with which the etching system used the electrode of an parallel monotonous type. That is, it is parallel to a substrate side, and a counterelectrode 6 is arranged on the location which countered, the inner circumference part of a magnetic disk 1 is put with the high-pressure impression electrode 7 from both sides like drawing 3 , and the spittle 10 of the ground electrode 2 is formed [it has the composition of having formed the floating electrode 9, in the form where it met at the periphery of a magnetic disk 1, and] in the location near a substrate side at the part to which an etch rate is changed. An etch rate can be changed by changing the consistency of the plasma 3 of this part from other places. It is possible to change the etching speed difference with a part without spittle by changing the distance (gap length 11) of this spittle and a substrate side. In this example, it carried out by changing gap length from 1 time of the die length of a sheath to 6 times. In addition, the radius of spittle 10 is 25mm.
[0018] The measure point was made into the center position R35 (usually section) without R20 (selective etching section) and the spittle of a center position with spittle 10. First, it saw about etching gas pressure dependence. This result was shown in drawing 4 . RF power and gap length at this time carried out by 100W or 10mm immobilization respectively. When it was the range of 50 - 1000mTorr as a process pressure for taking the etching speed difference of 0.5 or more nm/sec so that more clearly than this, it turned out that it is possible.
[0019] Next, the result of having followed RF injection power dependence is shown in drawing 5 . Since it did not change a lot as etching speed difference although the absolute etch rate increased even if it changed RF injection power so that it might see in drawing, it turned out that it is not necessary to specify as process conditions for this invention especially that what is necessary is just to set up by a tact time etc. about a setup of power.
[0020] The result of having followed the gap length considered below influencing the etching speed difference greatly in the case of etching was shown in drawing 6 . As proper gap length at the time of process gas pressure 100mTorr performed in this example from this, to the distance of an ion sheath being about 5mm, in about 10-25 2 to 5 times as manymm as this, the etching speed difference became large, and it turned out that it is good as a process.
[0021] In the above, the example of this invention has been explained. It is possible to form the field where concavo-convex height changes with one etching by this with a simultaneous and sufficient controllability. As an

example, when RF power and gap length were respectively set to 100W and 10mm, the 15nm hill was obtained in the CSS zone (part with spittle), and the 5nm hill was obtained in the data zone (part without spittle).
[0022] Although the above-mentioned example is based on the process shown in drawing 2 (a), it is also possible to consider as the magnetic disk of a configuration so that the location of the pars basilaris ossis occipitalis of the irregularity 17 of a data zone and the pars basilaris ossis occipitalis of the irregularity 18 of a CSS zone may be the same height according to the process shown in drawing 2 (b) and drawing 2 (c), as shown in drawing 7 . In addition, as for the substrate film and 15, in drawing, 14 is [a magnetic film and 16] protective coats.
[0023] After masking a carbon protective coat on the whole surface, masking a data zone at 10nm and the next and forming membranes 5nm only in a CSS zone, the process shown in drawing 2 (b) applies a particle 12 to the whole surface, hereafter, like the above-mentioned example, etches a CSS zone alternatively and performs it.
[0024] Moreover, the process shown in drawing 2 (c) is carried out like the next, and is performed. 10nm of data zones is etched without etching the gap length of the spittle on a CSS zone as 1mm, and etching a CSS zone, after forming each film to a carbon protective coat by the respectively same fixed thickness as the above like said example. Then, a particle 12 is applied to the whole surface and a CSS zone is hereafter etched alternatively like said example.
[0025] In addition, although each of each above-mentioned examples prepared the difference in the etch rate of two zones, they can prepare the plurality from which gap length differs, for example, two spittle, and can also prepare a difference in the etch rate of three zones. Moreover, as etching gas, although oxygen gas was used, whether it uses the gas of an argon, nitrogen, neon, a krypton, a fluorine, a fluorine compound, chlorine, or a chlorine compound or used these mixed gas, the same effectiveness was acquired.
[0026]
[Effect of the Invention] According to this invention, the irregularity from which height differs by one etching can be formed in coincidence. As compared with two, then the former, abbreviation one half and the plant-and-equipment investment amount of money serve as [a number of stroke] abbreviation half in the field which forms the irregularity from which height differs mutually. Moreover, the precision of concavo-convex formation improves and repeatability is secured. Since it is applicable as it is about the zone formation especially in a magnetic-recording medium, a highly precise magnetic-recording medium can be obtained that it is simple and cheaply.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention relates to the approach of forming irregularity in a substrate front face, and the manufacture approach of the magnetic-recording medium using the approach by etching.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In the field of the magnetic disk which is a magnetic-recording medium, high recording density-ization progresses quickly in recent years, therefore the flying height of the magnetic head is becoming low steadily. Although about 20nm of thickness of the protective coat of a magnetic disk had been made very thin from about 40nm that it should correspond to this, in order to maintain ********-proof, the limitation was generated naturally. Then, the data zone reduced the granularity of the front face, and lowered the flying height of the magnetic head, and the so-called zone texture method with which the front face of the zone (henceforth a CSS zone) for carrying out the contact start stop of the magnetic head makes granularity coarser than the front face of a data zone has been developed as indicated by JP,64-76555,A, JP,4-11324,A, etc.
[0003] Conventionally, the approach indicated by JP,3-295086,A is learned as the manufacture approach of such a magnetic disk. This approach forms the substrate film, a magnetic film, and a protective coat on a substrate, as shown in drawing 1 . The whole surface is etched after applying the particle 12 used as a mask to the protective coat front face of a CSS zone. A hill (heights) is formed in a CSS zone, a data zone is etched into the whole surface, next, a particle is again made into the whole surface with **, the whole surface is etched, and the hill where height differs is established in a data zone and a CSS zone, respectively. Moreover, after masking the CSS zone first and etching a data area into the whole surface, the approach of making a particle the whole surface with **, etching a CSS zone and a data zone into it separately respectively, and forming the same front face in it was also performed.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the irregularity from which height differs by one etching can be formed in coincidence. As compared with two, then the former, abbreviation one half and the plant-and-equipment investment amount of money serve as [a number of stroke] abbreviation half in the field which forms the irregularity from which height differs mutually. Moreover, the precision of concavo-convex formation improves and repeatability is secured. Since it is applicable as it is about the zone formation especially in a magnetic-recording medium, a highly precise magnetic-recording medium can be obtained that it is simple and cheaply.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The above-mentioned conventional technique required the above very complicated and long stroke. Therefore, there was a problem in respect of repeatability, precision, process tolerance, and facility cost.

[0005] When forming the irregularity from which height differs mutually by the field, it secures the repeatability in etching, and raises precision, and the 1st purpose of this invention shortens the stroke of concavo-convex formation, gives process tolerance, and is to offer the formation approach of the irregularity which enables control of the amount of capital investment further.

[0006] The 2nd purpose of this invention is to offer the manufacture approach of a magnetic-recording medium of having used the formation approach of such irregularity.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the 1st purpose of the above, the formation approach of the irregularity of this invention arranges the mask material which consists of a particle on the surface of a base, installs this in a vacuum housing, introduces etching gas into it, generates the plasma, etches a base front face, and forms the irregularity of height mutually different, respectively in two or more fields of a base at coincidence.

[0008] Moreover, in order to attain the 2nd purpose of the above, a magnetic film is prepared on a nonmagnetic substrate and it prepares a protective coat at least on it, or it described above the manufacture approach of the magnetic-recording medium of this invention on this, it applies the concavo-convex formation approach explained below, and forms the irregularity of mutually different height in two or more of those fields.
[0009] In order to form the irregularity of such mutually different height, it is desirable to change the consistency of the plasma mutually in the upper part of two or more fields. What is necessary is just to change partially the distance of a substrate and the counterelectrode which counters it, in order to change the consistency of the plasma partially. Although it cannot generally be determined since it is necessary to change this distance with a process gas pressure and and it changes also with the dimensions of a facility, it is desirable to make it into twice [about] the distance of the ion sheath about determined by the process gas pressure to about 5 times. Thereby, it can be 0.5nm [/second] or more separate with an etch rate. As for the difference of the etch rate of each field, it is desirable to consider as the range of 0.5 nm/sec - 3 nm/sec. Moreover, etching may be formed only in one field of a base, or may be formed in both sides at coincidence.
[0010] At least one sort of gas of oxygen, an argon, nitrogen, neon, a krypton, a fluorine, a fluorine compound, chlorine, and the chlorine compounds can be used for etching gas. That is, physical etching gas, such as argon gas, can also be used in addition to the gas of a reactive operation of oxygen etc.
[0011] Although a process gas pressure changes strictly with the types of gas and the etched ingredients to be used, when etching the carbon protective coat generally used with the magnetic disk, for example with oxygen gas, in order to secure 0.5 or more nm/sec for the etching speed difference, the range of about 50 mTorr(s) to 1Torr is suitable for it.
[0012] As for the mean particle diameter, it is [that the ingredient used from the former should just be used for the particle used as mask material] desirable that it is 0.1-1 micron phi extent. When forming irregularity in a magnetic-recording medium, as for the height, it is desirable that the lower one is 0nm - about several nm, and, as for the higher one, it is desirable that it is higher than it about 5-20nm.

[Translation done.]

OPERATION

[Function] As mentioned above, a partial etch rate can be gathered by raising a plasma consistency partially. When changing the distance of a substrate and the counterelectrode (ground electrode in this case) which counters, since the effect of electric field is so large that it is close to a counterelectrode, it becomes possible to raise the plasma consistency in that part. Thereby, a partial etch rate can be gathered. In addition, if distance of a substrate and a counterelectrode is made extremely narrow, the plasma will not generate this part but etching will be impossible in this part. If this approach is used, the field where concavo-convex height is different by one etching can be formed in coincidence, and the process precision of the etching [itself] will also improve sharply by compaction of a process, and simplification.

[Translation done.]

EXAMPLE

[Example] Hereafter, the example of this invention is explained to a detail. First, the contents of evaluation and an approach are explained. The amount of etching measured and computed the height of the irregularity after etching using the sensing-pin-type surface roughness meter. The measurement machine used for measurement used the three-dimension surface roughness meter by Kosaka Laboratory, Ltd. The etch rate was deduced from this data as an amount of etching per unit time amount.
[0015] The process shown in drawing 2 (a) performed the experiment procedure. Surface roughness Ra carried out nickel-P plating, using a super polish substrate (the Sumitomo light metal company make, the aluminum, diameter of 95mm) 1.0nm or less as a substrate for magnetic disks, and what formed the chromium film with a thickness of 35nm, the cobalt alloy magnetic film with a thickness of 30nm, and the carbon protective coat with a thickness of 25nm as substrate film was prepared by sputtering.
[0016] The liquid which made the solvent distribute the particle 12 of the Teflon of 1 micron phi used as mask material all over the protective coat side (spatter carbon) of this magnetic disk is sprayed. After carrying out with ** by 5% per area of consistency, it sets into the etching system explained in full detail behind. Perform evacuation for the inside of a vacuum housing to 1x10 to 5 or less Torrs, and, subsequently to in a container, oxygen gas (purity 99.99up%) is sent in as etching gas. After making it fixed to the pressure (this example 1mTorr - 5Torr) of a request of the pressure in a container, the protective coat on the front face of a substrate was etched into the substrate for RF power (13.56MHz) fixed power (this example 50 W-500W) and by carrying out fixed time amount impression. Washing removal of the Teflon particle of mask material was carried out by washing in cold water after this, and it evaluated by carrying out spin desiccation.
[0017] The electrode configuration used what was shown in drawing 3 with the equipment with which the etching system used the electrode of an parallel monotonous type. That is, it is parallel to a substrate side, and a counterelectrode 6 is arranged on the location which countered, the inner circumference part of a magnetic disk 1 is put with the high-pressure impression electrode 7 from both sides like drawing 3 , and the spittle 10 of the ground electrode 2 is formed [it has the composition of having formed the floating electrode 9, in the form where it met at the periphery of a magnetic disk 1, and] in the location near a substrate side at the part to which an etch rate is changed. An etch rate can be changed by changing the consistency of the plasma 3 of this part from other places. It is possible to change the etching speed difference with a part without spittle by changing the distance (gap length 11) of this spittle and a substrate side. In this example, it carried out by changing gap length from 1 time of the die length of a sheath to 6 times. In addition, the radius of spittle 10 is 25mm.
[0018] The measure point was made into the center position R35 (usually section) without R20 (selective etching section) and the spittle of a center position with spittle 10. First, it saw about etching gas pressure dependence. This result was shown in drawing 4 . RF power and gap length at this time carried out by 100W or 10mm immobilization respectively. When it was the range of 50 - 1000mTorr as a process pressure for taking the etching speed difference of 0.5 or more nm/sec so that more clearly than this, it turned out that it is possible.
[0019] Next, the result of having followed RF injection power dependence is shown in drawing 5 . Since it did not change a lot as etching speed difference although the absolute etch rate increased even if it changed RF injection power so that it might see in drawing, it turned out that it is not necessary to specify as process conditions for this invention especially that what is necessary is just to set up by a tact time etc. about a setup of power.
[0020] The result of having followed the gap length considered below influencing the etching speed difference greatly in the case of etching was shown in drawing 6 . As proper gap length at the time of process gas pressure 100mTorr performed in this example from this, to the distance of an ion sheath being about 5mm, in about 10-25 2 to 5 times as manymm as this, the etching speed difference became large, and it turned out that it is good as a process.
[0021] In the above, the example of this invention has been explained. It is possible to form the field where concavo-convex height changes with one etching by this with a simultaneous and sufficient controllability. As an example, when RF power and gap length were respectively set to 100W and 10mm, the 15nm hill was obtained in the CSS zone (part with spittle), and the 5nm hill was obtained in the data zone (part without spittle).
[0022] Although the above-mentioned example is based on the process shown in drawing 2 (a), it is also possible to consider as the magnetic disk of a configuration so that the location of the pars basilaris ossis occipitalis of the irregularity 17 of a data zone and the pars basilaris ossis occipitalis of the irregularity 18 of a CSS zone may be the same height according to the process shown in drawing 2 (b) and drawing 2 (c), as shown in drawing 7 . In addition, as for the substrate film and 15, in drawing, 14 is [a magnetic film and 16] protective coats.

[0023] After masking a carbon protective coat on the whole surface, masking a data zone at 10nm and the next and forming membranes 5nm only in a CSS zone, the process shown in drawing 2 (b) applies a particle 12 to the whole surface, hereafter, like the above-mentioned example, etches a CSS zone alternatively and performs it.
[0024] Moreover, the process shown in drawing 2 (c) is carried out like the next, and is performed. 10nm of data zones is etched without etching the gap length of the spittle on a CSS zone as 1mm, and etching a CSS zone, after forming each film to a carbon protective coat by the respectively same fixed thickness as the above like said example. Then, a particle 12 is applied to the whole surface and a CSS zone is hereafter etched alternatively like said example.
[0025] In addition, although each of each above-mentioned examples prepared the difference in the etch rate of two zones, they can prepare the plurality from which gap length differs, for example, two spittle, and can also prepare a difference in the etch rate of three zones. Moreover, as etching gas, although oxygen gas was used, whether it uses the gas of an argon, nitrogen, neon, a krypton, a fluorine, a fluorine compound, chlorine, or a chlorine compound or used these mixed gas, the same effectiveness was acquired.

[Translation done.]

DESCRIPTION OF DRAWINGS

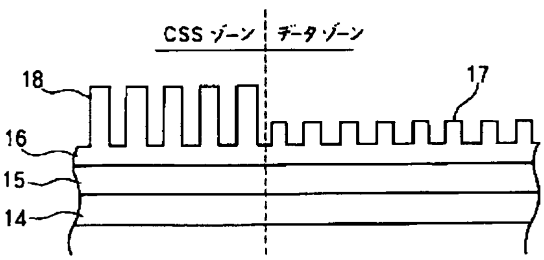
[Brief Description of the Drawings]
[Drawing 1] The process schematic diagram of the conventional approach.
[Drawing 2] The process schematic diagram by this invention.
[Drawing 3] The electrode structure illustration used by this invention.
[Drawing 4] The related Fig. of an etch rate and a pressure obtained in the example.
[Drawing 5] The related Fig. of an etch rate and injection power obtained in the example.
[Drawing 6] The related Fig. of the etch rate and gap length who got in the example.
[Drawing 7] The block diagram of the magnetic disk obtained in the one example of this invention.
[Description of Notations]
1 -- Magnetic disk
2 -- Ground electrode
3 -- Plasma
6 -- Counterelectrode
7 -- High-pressure impression electrode
9 -- Floating electrode
10 -- Spittle
11 -- Gap length
12 -- Particle
14 -- Substrate film
15 -- Magnetic film
16 -- Protective coat
17 18 -- Irregularity

[Translation done.]

DRAWINGS

[Drawing 7]

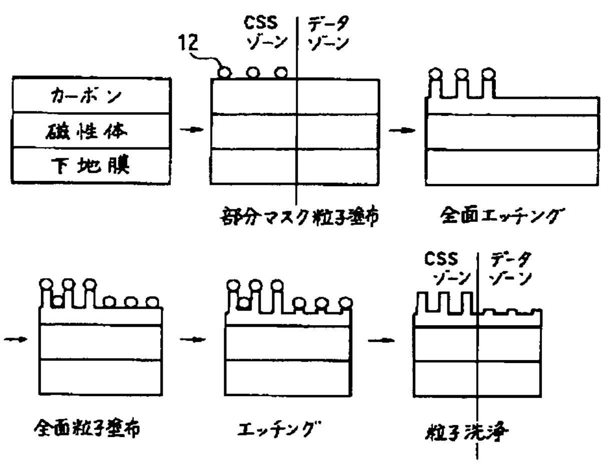
図7



16……保護膜
17.18…凹凸

[Drawing 1]

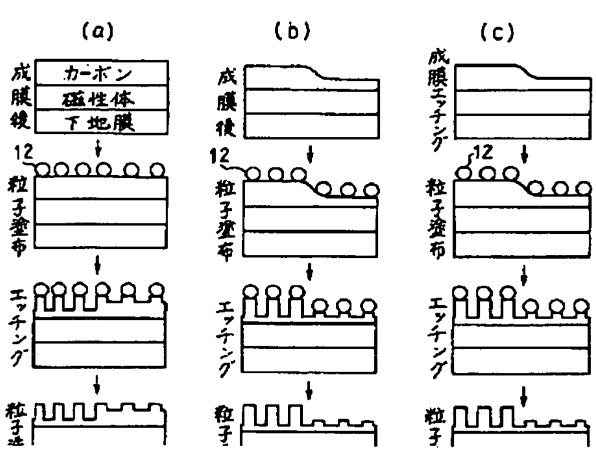
図1

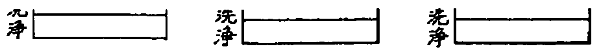


12…微粒子

[Drawing 2]

図2

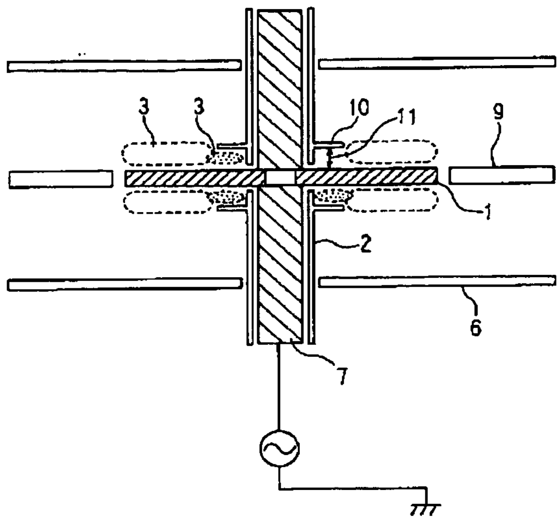




12… 微粒子

[Drawing 3]

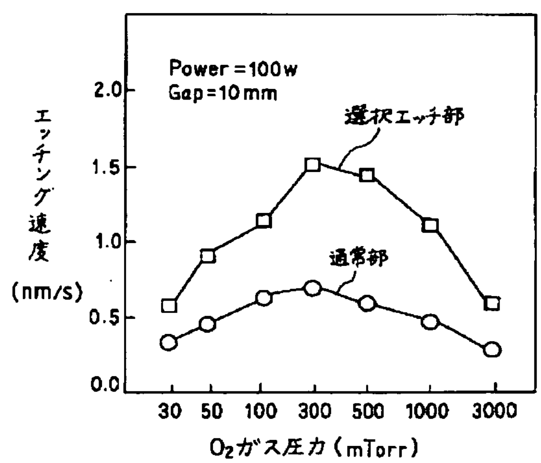
図3



1…磁気ディスク
2…アース電極
3…プラズマ
6…対向電極
7…高圧印加電極
9…フローティング電極
10…ツバ

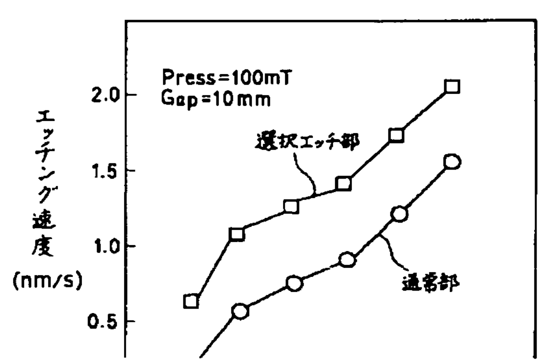
[Drawing 4]

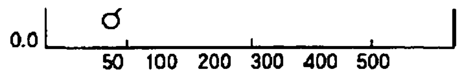
図4



[Drawing 5]

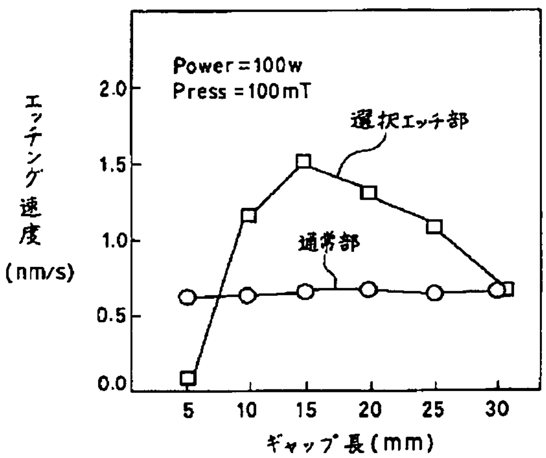
図5





[Drawing 6]

図6



[Translation done.]

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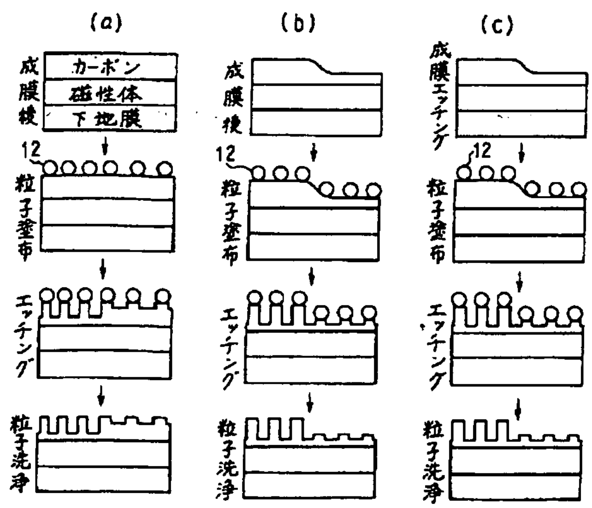
(54)【発明の名称】　凹凸の形成方法及び磁気記録媒体の製造方法

(57)【要約】

【目的】領域により互いに高さの異なる凹凸を形成するときに、エッチングの再現性を確保し、精度を向上させ、凹凸形成の行程を短縮し、プロセス裕度を持たせ、さらに設備投資額の抑制を可能とする凹凸の形成方法を提供すること。

【構成】基体の表面に微粒子１２からなるマスク材を配置し、これを真空容器内に設置し、その中にエッチングガスを導入し、プラズマを発生させ、プラズマの密度を部分的に変化させて基体表面をエッチングして、基体の複数の領域に、それぞれ互いに異なる高さの凹凸を同時に形成する凹凸の形成方法。

図2



12…微粒子

【特許請求の範囲】

【請求項１】表面に微粒子からなるマスク材が配置された基体を真空容器内に設置し、真空容器内に所望のエッチングガスを導入し、プラズマを発生させ、基体表面をエッチングし、基体の複数の領域に、それぞれ互いに異なる高さの凹凸を同時に形成することを特徴とする凹凸の形成方法。

【請求項２】上記互いに異なる高さの凹凸の形成は、上記複数の領域の上部で上記プラズマの密度を互いに変えることにより行うことを特徴とする請求項１記載の凹凸の形成方法。

【請求項３】上記エッチングガスは、酸素、アルゴン、窒素、ネオン、クリプトン、フッ素、フッ素化合物、塩素及び塩素化合物からなる群から選ばれた少なくとも１種のガスであることを特徴とする請求項１又は２記載の凹凸の形成方法。

【請求項４】上記エッチングは、０．０５Ｔｏｒｒ～１．０Ｔｏｒｒの範囲の圧力で行うことを特徴とする請求項１から３のいずれか一に記載の凹凸の形成方法。

【請求項５】上記エッチングは、上記複数の領域のエッチング速度の差が０．５ｎｍ／ｓｅｃ～３ｎｍ／ｓｅｃの範囲となる条件で行うことを特徴とする請求項１から４のいずれか一に記載の凹凸の形成方法。

【請求項６】非磁性基板上に磁性膜を形成する工程と、該磁性膜上に保護膜を形成する工程と、請求項１から５のいずれか一に記載の凹凸の形成方法を適用し、上記保護膜の複数の領域に互いに異なる高さの凹凸を形成する工程とを有すること特徴とする磁気記録媒体の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、エッチングにより、基板表面に凹凸を形成する方法及びその方法を用いた磁気記録媒体の製造方法に関する。

【０００２】

【従来の技術】近年、磁気記録媒体である磁気ディスクの分野では高記録密度化が急速に進み、そのため磁気ヘッドの浮上量は低くなる一方である。これに対応すべく磁気ディスクの保護膜の膜厚を４０ｎｍ程度から２０ｎｍ程度へと極めて薄くしてきたが、耐習動特性を維持するためには自ずと限界が生じた。そこで、特開昭６４－７６５５５、特開平４－１１３２４等に開示されているように、データゾーンは、その表面の粗さを低下させて磁気ヘッドの浮上量を下げ、磁気ヘッドをコンタクト・スタート・ストップさせるためのゾーン（以下、ＣＳＳゾーンという）の表面はデータゾーンの表面よりも粗さを粗くする、いわゆるゾーンテクスチャー方式が開発されてきた。

【０００３】従来、このような磁気ディスクの製造方法として、特開平３－２９５０８６に記載されている方法が知られている。この方法は、図１に示すように、基板上に、下地膜、磁性膜、保護膜を形成し、ＣＳＳゾーンの保護膜表面にマスクとなる微粒子１２を塗布した後全面をエッチングし、ＣＳＳゾーンに丘（凸部）を形成し、データゾーンは一面にエッチングし、次ぎに、再度微粒子を全面に塗付し、全面をエッチングして、高さの異なる丘をデータゾーンとＣＳＳゾーンにそれぞれ設けるものである。また、最初にＣＳＳゾーンをマスキングしてデータエリアを一面にエッチングした後、全面に微粒子を塗付し、ＣＳＳゾーンとデータゾーンを各々別々にエッチングして同様な表面を形成する方法も行われていた。

【０００４】

【発明が解決しようとする課題】上記従来技術は、上述のように非常に繁雑で長い行程を要した。そのため、再現性、精度、プロセス裕度及び設備コストの点で問題があった。

【０００５】本発明の第１の目的は、領域により互いに高さの異なる凹凸を形成するときに、エッチングにおける再現性を確保し、精度を向上させ、凹凸形成の行程を短縮し、プロセス裕度を持たせ、さらに設備投資額の抑制を可能とする凹凸の形成方法を提供することにある。

【０００６】本発明の第２の目的は、そのような凹凸の形成方法を用いた磁気記録媒体の製造方法を提供することにある。

【０００７】

【課題を解決するための手段】上記第１の目的を達成するために、本発明の凹凸の形成方法は、基体の表面に微粒子からなるマスク材を配置し、これを真空容器内に設置し、その中にエッチングガスを導入し、プラズマを発生させ、基体表面をエッチングして、基体の複数の領域に、それぞれ互いに異なる高さの凹凸を同時に形成するようにしたものである。

【０００８】また、上記第２の目的を達成するために、本発明の磁気記録媒体の製造方法は、非磁性基板上に、磁性膜を、その上に保護膜を少なくとも設け、この上に上記した或は以下に説明する凹凸の形成方法を適用し、その複数の領域に互いに異なる高さの凹凸を形成するようにしたものである。

【０００９】このような互いに異なる高さの凹凸を形成するには、複数の領域の上部でプラズマの密度を互いに変えることが好ましい。プラズマの密度を部分的に変化させるには、基板とそれに対向する対向電極との距離を部分的に変化させればよい。この距離は、プロセスガス圧力により変化させる必要があり、また、設備のディメンジョンによっても変化するため一概に決定できないが、凡そプロセスガス圧力で決定されるイオンシースの距離の約２倍から５倍程度とすることが好ましい。これによりエッチング速度で０．５ｎｍ／秒以上の差をつけることができる。各領域のエッチング速度の差は、０．

5nm／sec～3nm／secの範囲とすることが好ましい。また、エッチングは、基体の1つの面だけに形成しても、両面に同時に形成してもよい。

【0010】エッチングガスは、酸素、アルゴン、窒素、ネオン、クリプトン、フッ素、フッ素化合物、塩素及び塩素化合物の内の少なくとも1種のガスを用いることができる。つまり、酸素等のリアクティブな作用のガス以外に、アルゴンガス等の物理的なエッチングガスを用いることもできる。

【0011】プロセスガス圧力は、使用するガス種、被エッチング材料により厳密には異なるが、例えば、磁気ディスクで一般的に用いられているカーボン保護膜を酸素ガスによりエッチングする場合、エッチング速度差を0．5nm／sec以上を確保するためには、凡そ50mTorrから1Torrの範囲が適切である。

【0012】マスク材として用いる微粒子は、従来から用いられている材料を用いればよく、その平均粒径は0．1～1ミクロンφ程度であることが好ましい。磁気記録媒体に凹凸を形成するとき、その高さは、低い方が0nm～数nm程度であることが好ましく、高い方はそれより5～20nm程度高いことが好ましい。

【0013】

【作用】上述のように、部分的にプラズマ密度を上げることにより、部分的なエッチング速度を上げることができる。基板と対向する対向電極（この場合アース電極）の距離を変化させたとき、対向電極に近いほど電界の影響が大きいことからその部分でのプラズマ密度を上げることが可能となる。これにより部分的なエッチング速度を上げることができる。なお、基板と対向電極の距離を極端に狭くすれば、この部分はプラズマが発生せず、この部分ではエッチングはできない。この方法を使用すれば一回のエッチングにより凹凸の高さの違う面を同時に形成でき、プロセスの短縮、簡略化によりエッチング自体のプロセス精度も大幅に向上する。

【0014】

【実施例】以下、本発明の実施例を詳細に説明する。まず、評価内容と方法について説明する。エッチング量は、触針式の表面粗さ計を用いてエッチング後の凹凸の高さを測定して算出した。測定に用いた測定機は小坂研究所社製の3次元表面粗さ計を用いた。エッチング速度はこのデータから単位時間当たりのエッチング量として割り出した。

【0015】実験手順は図2（a）に示す工程により行った。磁気ディスク用基板としては表面粗さRaが1．0nm以下のスーパーポリッシュ基板（住友軽金属社製、アルミニュウム、直径95mm）を用い、Ni－Pメッキし、スパッタリングにより、下地膜として厚さ35nmのクロム膜、厚さ30nmのコバルト合金磁性膜、厚さ25nmのカーボン保護膜を成膜したものを準備した。

【0016】この磁気ディスクの保護膜面（スパッタカーボン）全面に、マスク材となる1ミクロンφのテフロンの微粒子12を溶剤に分散させた液を噴霧し、面積当たり5％の密度で塗付した後、後に詳述するエッチング装置の中にセットし、真空容器内を1×10^{-5}Torr以下まで真空排気を行い、ついでエッチングガスとして酸素ガス（純度99．99up％）を容器内に送り込み、容器内の圧力を所望の圧力（本実施例では1mTorr～5Torr）に一定にした後、基板にRF電力（13．56MHz）を一定パワー（本実施例では50W～500W）、一定時間印加することにより基板表面の保護膜をエッチングした。この後マスク材のテフロン微粒子を水洗いにより洗浄除去し、スピン乾燥し、評価を行った。

【0017】エッチング装置は平行平板式の電極を用いた装置で電極構成は図3に示したものを用いた。つまり、図3のように、磁気ディスク1の内周部分を両面から高圧印加電極7により挟み込み、基板面に平行な、かつ、対向した位置に、対向電極6を配し、磁気ディスク1の外周に沿った形でフローティング電極9を設けた構成となっており、エッチング速度を変化させる部分には基板面に近い位置にアース電極2のツバ10を設けてある。この部分のプラズマ3の密度を他のところより変えることでエッチング速度を変化させることができる。このツバと基板面との距離（ギャップ長11）を変化させることで、ツバのない部分とのエッチング速度差を変えることが可能である。本実施例ではギャップ長をシースの長さの1倍から6倍まで変化させて行った。なお、ツバ10の半径は25mmである。

【0018】測定ポイントはツバ10のある中心位置のR20（選択エッチング部）とツバのない中心位置R35（通常部）とした。まず、エッチングガス圧力依存について見た。この結果を図4に示した。このときのRFパワーとギャップ長は各々100W、10mm固定で行った。これより明らかなように0．5nm／sec以上のエッチング速度差を取るにはプロセス圧力としては50～1000mTorrの範囲であれば可能であることが分かった。

【0019】次にRF投入パワー依存について行った結果を図5に示す。図に見られるように、RF投入パワーを変化させても絶対的なエッチング速度は増すが、エッチング速度差としては大きく変化しないことから、パワーの設定に関してはタクトタイム等により設定すればよく、特に本発明のプロセス条件として規定する必要はないことが分かった。

【0020】つぎに、エッチングの際大きくエッチング速度差に影響すると考えられるギャップ長について行った結果を図6に示した。これより本実施例において行ったプロセスガス圧力100mTorr時の適正ギャップ長としては、イオンシースの距離が凡そ5mmであるの

に対して、2から5倍の１０～２５ｍｍ程度においてエッチング速度差が大きくなり、プロセスとして良好であることが分かった。

【００２１】以上、本発明の実施例について説明してきた。これにより一回のエッチングにより凹凸の高さの異なる面を同時に、かつ、制御性良く形成することが可能である。一例として、ＲＦパワーとギャップ長を各々１００Ｗ、１０ｍｍとしたとき、ＣＳＳゾーン（ツバのある部分）で１５ｎｍの丘が、データゾーン（ツバのない部分）で５ｎｍの丘が得られた。

【００２２】上記実施例は、図２（ａ）に示した工程によるものであるが、図２（ｂ）、図２（ｃ）に示した工程により、図７に示したように、データゾーンの凹凸１７の底部とＣＳＳゾーンの凹凸１８の底部の位置が同じ高さであるような構成の磁気ディスクとすることも可能である。なお、図において１４は下地膜、１５は磁性膜、１６は保護膜である。

【００２３】図２（ｂ）に示した工程は、カーボン保護膜を、全面に１０ｎｍ、次ぎにデータゾーンをマスキングしてＣＳＳゾーンのみに５ｎｍ成膜した後、全面に微粒子１２を塗布し、以下、上記実施例と同様にＣＳＳゾーンを選択的にエッチングして行うものである。

【００２４】また、図２（ｃ）に示した工程は次ぎのようにして行う。前記実施例と同様にカーボン保護膜までの各膜をそれぞれ前記と同じ一定の厚さで成膜した後、ＣＳＳゾーンの上のツバのギャップ長を１ｍｍとしてエッチングし、ＣＳＳゾーンをエッチングすることなく、データゾーンを１０ｎｍエッチングする。その後、全面に微粒子１２を塗布し、以下、前記実施例と同様にＣＳＳゾーンを選択的にエッチングする。

【００２５】なお、上記各実施例は、いずれも２つのゾーンのエッチング速度に差を設けたが、ギャップ長の異なる複数の、例えば、２つのツバを設け、３つのゾーンのエッチング速度に差を設けることもできる。また、エッチングガスとしては、酸素ガスを用いたが、アルゴン、窒素、ネオン、クリプトン、フッ素、フッ素化合物、塩素又は塩素化合物のガスを用いても、また、これらの混合ガスを用いても同様な効果が得られた。

【００２６】

【発明の効果】本発明によれば、一回のエッチングにより高さの異なる凹凸を同時に形成できる。互いに高さの異なる凹凸を形成する領域を２つとすれば、従来と比較し、行程数が約半分、設備投資金額が約半分となる。また、凹凸形成の精度が向上し、再現性が確保される。特に磁気記録媒体におけるゾーン形成についてはそのまま適用できるため、高精度の磁気記録媒体を簡便に、かつ、安価に得ることができる。

【図面の簡単な説明】

【図１】従来方法のプロセス概略図。

【図２】本発明によるプロセス概略図。

【図３】本発明で用いた電極構造模式図。

【図４】実施例で得たエッチング速度と圧力の関係図。

【図５】実施例で得たエッチング速度と投入パワーの関係図。

【図６】実施例で得たエッチング速度とギャップ長の関係図。

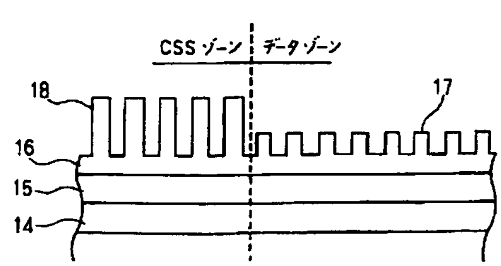
【図７】本発明の一実施例で得た磁気ディスクの構成図。

【符号の説明】

１…磁気ディスク
２…アース電極
３…プラズマ
６…対向電極
７…高圧印加電極
９…フローティング電極
１０…ツバ
１１…ギャップ長
１２…微粒子
１４…下地膜
１５…磁性膜
１６…保護膜
１７、１８…凹凸

【図７】

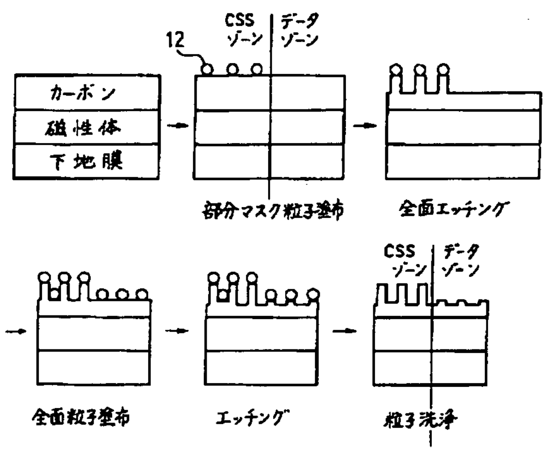
図７



16……保護膜
17，18…凹凸

【図１】

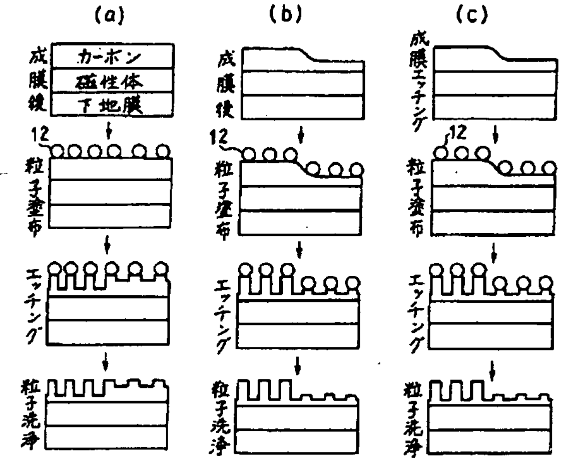
図1



12…微粒子

【図２】

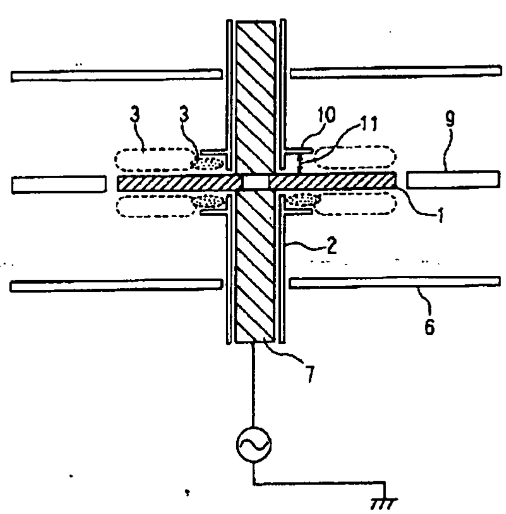
図2



12… 微粒子

【図３】

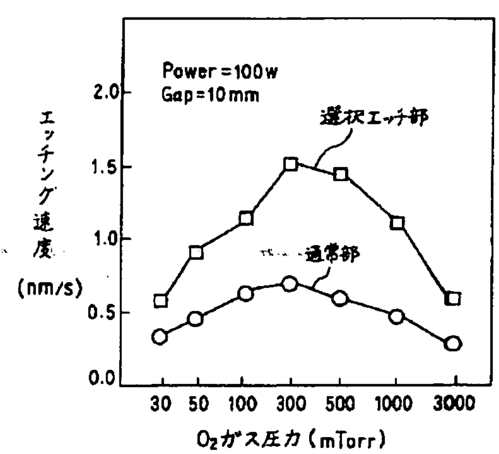
図3



1…磁気ディスク
2…アース電極
3…プラズマ
6…対向電極
7…高圧印加電極
9…フローティング電極
１０…ツバ

【図４】

図4



【図5】

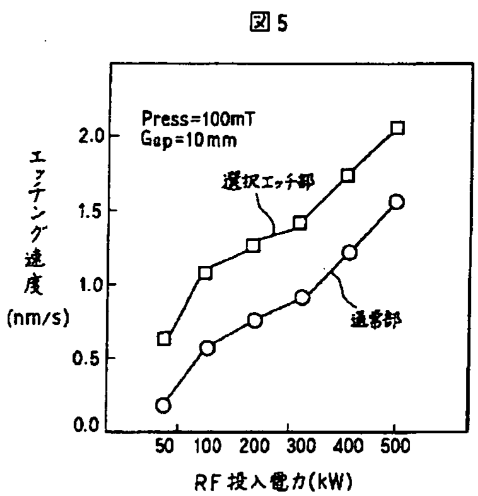


図5
Press=100mT
Gap=10mm
選択エッチ部
通常部
エッチング速度 (nm/s)
0.0
0.5
1.0
1.5
2.0
50 100 200 300 400 500
RF投入電力(kW)

【図6】

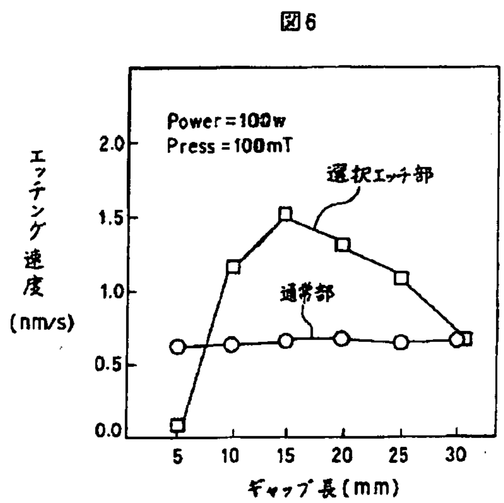


図6
Power=100w
Press=100mT
選択エッチ部
通常部
エッチング速度 (nm/s)
0.0
0.5
1.0
1.5
2.0
5 10 15 20 25 30
ギャップ長(mm)